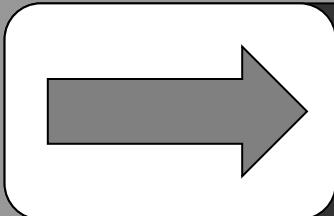


Wed Oct 1st 2014.

CIVL 498C Life Cycle Assessment

Week 5: Quantity Takeoffs and Construction Formats



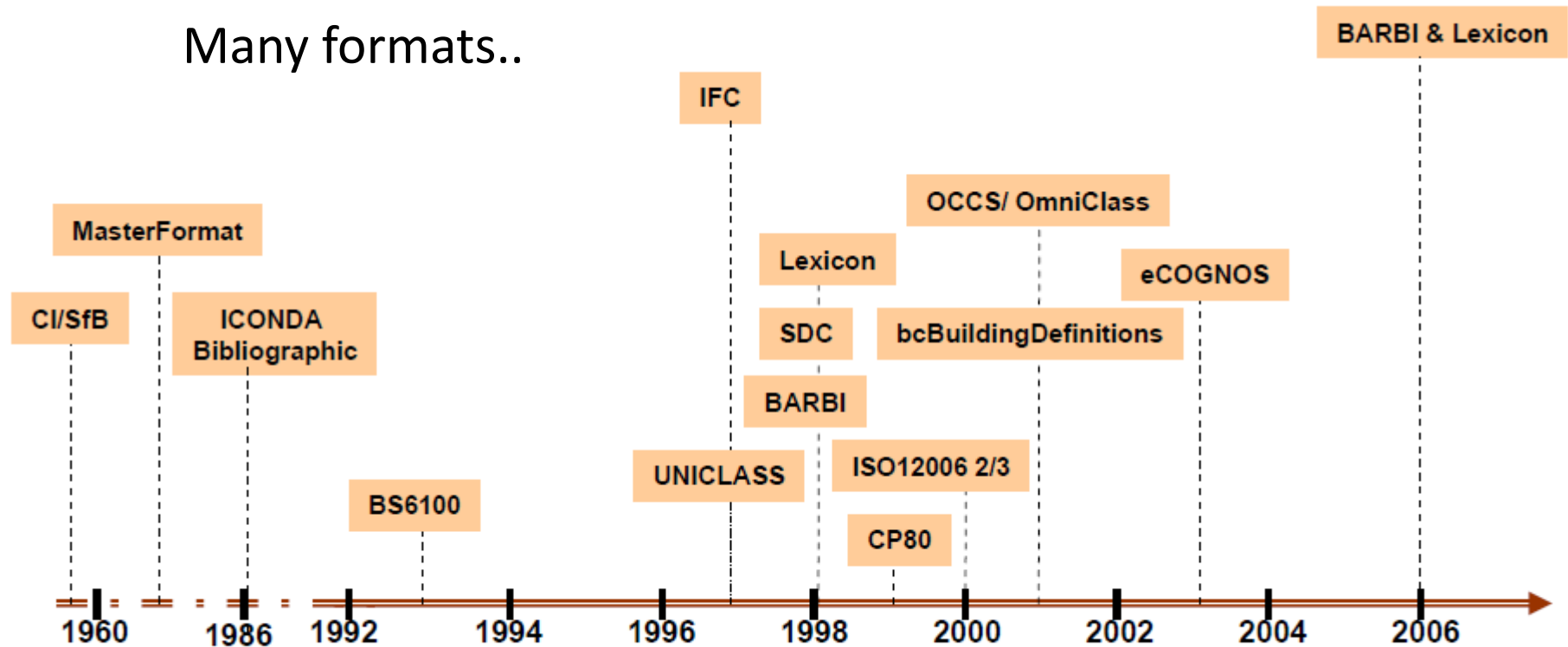
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Presentation Outline

- 1. Construction Formats**
2. Quantity Takeoffs

Construction Formats

Many formats..



Examples of worldwide controlled vocabulary (CV) initiatives for the construction industry.

Construction Formats

CIQS and UniFormat

- Organized around where the construction item is.
- Used in the planning stage of a project.
- Use to
 - achieve consistency in economic evaluation of projects,
 - enhance reporting of design program information, and
 - promote consistency in filing information for facility management, drawing details and construction market data

MasterFormat

- Organized around what the construction item is.
- Used when detailed construction information is required on the basis of materials or methods.
- Used to
 - organize specifications, and
 - contracting and procurement requirements.

Uniformat Elemental Construction Format

Level 1 Major Group Elements	Level 2 Group Elements	Level 3 Individual Elements
A SUBSTRUCTURE	A10 Foundations	A1010 Standard Foundations A1020 Special Foundations A1030 Slab on Grade
	A20 Basement Construction	A2010 Basement Excavation A2020 Basement Walls
B SHELL	B10 Superstructure	B1010 Floor Construction B1020 Roof Construction
	B20 Exterior Enclosure	B2010 Exterior Walls B2020 Exterior Windows B2030 Exterior Doors
	B30 Roofing	B3010 Roof Coverings B3020 Roof Openings
C INTERIORS	C10 Interior Construction	C1010 Partitions C1020 Interior Doors C1030 Fittings
	C20 Stairs	C2010 Stair Construction C2020 Stair Finishes
	C30 Interior Finishes	C3010 Wall Finishes C3020 Floor Finishes C3030 Ceiling Finishes
D SERVICES	D10 Conveying	D1010 Elevators & Lifts D1020 Escalators & Moving Walks D1090 Other Conveying Systems
	D20 Plumbing	D2010 Plumbing Fixtures D2020 Domestic Water Distribution D2030 Sanitary Waste D2040 Rain Water Drainage D2090 Other Plumbing Systems
	D30 HVAC	D3010 Energy Supply D3020 Heat Generating Systems D3030 Cooling Generating Systems D3040 Distribution Systems D3050 Terminal & Package Units D3060 Controls and Instrumentation D3070 Systems Testing & Balancing D3090 Other HVAC Systems & Equipment
	D40 Fire Protection	D4010 Sprinklers D4020 Standpipes D4030 Fire Protection Specialties D4090 Other Fire Protection Systems
	D50 Electrical	D5010 Electrical Service & Distribution D5020 Lighting and Branch Wiring D5030 Communications & Security D5090 Other Electrical Systems
E EQUIPMENT & FURNISHINGS	E10 Equipment	E1010 Commercial Equipment E1020 Institutional Equipment E1030 Vehicular Equipment E1090 Other Equipment
	E20 Furnishings	E2010 Fixed Furnishings E2020 Movable Furnishings
F SPECIAL CONSTRUCTION & DEMOLITION	F10 Special Construction	F1010 Special Structures F1020 Integrated Construction F1030 Special Construction Systems F1040 Special Facilities F1050 Special Controls and Instrumentation
	F20 Selective Building Demolition	F2010 Building Elements Demolition F2020 Hazardous Components Abatement

CIQS Elemental Construction Format

A SHELL		B INTERIORS	
A1	SUBSTRUCTURE	B1	PARTITIONS & DOORS
A11	Foundations	B11	Partitions
	A111 Standard Foundations		B111 Fixed Partitions
	A112 Special Foundations		B112 Movable Partitions
A12	Basement Excavation		B113 Structural Partitions
		B12	Doors
A2	STRUCTURE	B2	FINISHES
A21	Lowest Floor Construction	B21	Floor Finishes
A22	Upper Floor Construction	B22	Ceiling Finishes
	A221 Upper Floor Construction	B23	Wall Finishes
	A222 Stair Construction		
A23	Roof Construction	B3	FITTINGS & EQUIPMENT
A3	EXTERIOR ENCLOSURE	B31	Fittings & Fixtures
A31	Walls Below Grade		B311 Metals
	A311 Walls Below Grade		B312 Millwork
	A312 Structural Walls Below Grade		B313 Specialties
A32	Walls Above Grade		B314 Furniture
	A321 Walls Above Grade	B32	Equipment
	A322 Structural Walls Above Grade	B33	Conveying Systems
	A323 Curtain Walls		B331 Elevators
A33	Windows & Entrances		B332 Escalators & Moving Walks
	A331 Windows & Louvres		B333 Material Handling Systems
	A332 Glazed Screens		
	A333 Doors		
A34	Roof Covering		
	A341 Roofing		
	A342 Skylights & Roof Glazing		
A35	Projections		
C SERVICES		D SITE & ANCILLARY WORK	
C1	MECHANICAL	D1	SITE WORK
C11	Plumbing & Drainage	D11	Site Development
	C111 Equipment		D111 Preparation
	C112 Piping	D112	Hard Surfaces
	C113 Fixtures		D113 Improvements
	C114 Special Piping & Fixtures		D114 Landscaping
C12	Fire Protection	D12	Mechanical Site Services
	C121 Equipment	D13	Electrical Site Services
	C122 Piping & Sprinkler Heads		
C13	HVAC	D2	ANCILLARY WORK
	C131 Equipment	D21	Demolition
	C132 Ductwork		D211 Demolition
	C133 Piping		D212 Hazardous Materials
	C134 Ductwork Terminal Devices	D22	Alterations
	C135 Piping Terminal Devices		
C14	Controls	Z	GENERAL REQUIREMENTS & ALLOWANCES
	C141 Central Equipment	Z1	GENERAL REQUIREMENTS & FEE
	C142 Control Points		Z11 General Requirements
C2	ELECTRICAL		Z111 Supervision & Labour Expenses
C21	Service & Distribution		Z112 Temporary
	C211 Equipment		Z113 Permits, Insurance & Bonds
	C212 Auxiliary Power Equipment		
	C213 Distribution Conditions		
	C214 Motor Controls		
C22	Lighting, Devices & Heating		
	C221 Lighting	Z12	Fee
	C222 Devices	Z2	ALLOWANCES
	C223 Heating		Z21 Design Allowance
C23	Systems & Ancillaries		Z22 Escalation Allowance
	C231 Fire Alarm		Z23 Construction Allowance
	C232 Communications		
	C233 Security		
	C234 Other Systems & Ancillaries		

MasterFormat Construction Format

03 00 00 Concrete

03 01 00 Maintenance of Concrete

03 01 10	Maintenance of Concrete Forming and Accessories
03 01 20	Maintenance of Concrete Reinforcing
03 01 23	Maintenance of Stressing Tendons
03 01 30	Maintenance of Cast-in-Place Concrete
03 01 30.51	Cleaning of Cast-in-Place Concrete
03 01 30.61	Resurfacing of Cast-in-Place Concrete
03 01 30.71	Rehabilitation of Cast-in-Place Concrete
03 01 30.72	Strengthening of Cast-in-Place Concrete
03 01 40	Maintenance of Precast Concrete
03 01 40.51	Cleaning of Precast Concrete
03 01 40.61	Resurfacing of Precast Concrete
03 01 40.71	Rehabilitation of Precast Concrete
03 01 40.72	Strengthening of Precast Concrete
03 01 50	Maintenance of Cast Decks and Underlayment
03 01 50.51	Cleaning Cast Decks and Underlayment
03 01 50.61	Resurfacing of Cast Decks and Underlayment
03 01 50.71	Rehabilitation of Cast Decks and Underlayment
03 01 50.72	Strengthening of Cast Decks and Underlayment
03 01 60	Maintenance of Grouting
03 01 70	Maintenance of Mass Concrete
03 01 80	Maintenance of Concrete Cutting and Boring

MasterFormat 2004 Edition Division Numbers and Titles

Procurement and Contracting Requirements Group

Div. 00	Procurement and Contracting Requirements
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Specifications Group

General Requirements Subgroup	
Div. 01	General Requirements

Facility Construction Subgroup

Div. 02	Existing Conditions
Div. 03	Concrete
Div. 04	Masonry
Div. 05	Metals
Div. 06	Wood, Plastics, and Composites
Div. 07	Thermal and Moisture Protection
Div. 08	Openings
Div. 09	Finishes
Div. 10	Specialties
Div. 11	Equipment
Div. 12	Furnishings
Div. 13	Special Construction
Div. 14	Conveying Equipment
Div. 15	Reserved for Future Expansion
Div. 16	Reserved for Future Expansion
Div. 17	Reserved for Future Expansion
Div. 18	Reserved for Future Expansion
Div. 19	Reserved for Future Expansion

Facility Services Subgroup

Div. 20	Reserved for Future Expansion
Div. 21	Fire Suppression
Div. 22	Plumbing
Div. 23	HVAC
Div. 24	Reserved for Future Expansion
Div. 25	Integrated Automation
Div. 26	Electrical
Div. 27	Communications
Div. 28	Electronic Safety and Security
Div. 29	Reserved for Future Expansion

Site and Infrastructure Subgroup

Div. 30	Reserved for Future Expansion
Div. 31	Earthwork
Div. 32	Exterior Improvements
Div. 33	Utilities
Div. 34	Transportation
Div. 35	Waterway and Marine
Div. 36	Reserved for Future Expansion
Div. 37	Reserved for Future Expansion
Div. 38	Reserved for Future Expansion
Div. 39	Reserved for Future Expansion

Process Equipment Subgroup

Div. 40	Process Integration
Div. 41	Material Processing and Handling
Div. 42	Equipment Process Heating, Cooling, and Drying Equipment
Div. 43	Process Gas and Liquid Handling,
	Purification and Storage Equipment
Div. 44	Pollution Control Equipment
Div. 45	Industry-specific Manufacturing Equipment
Div. 46	Reserved for Future Expansion
Div. 47	Reserved for Future Expansion
Div. 48	Electrical Power Generation
Div. 49	Reserved for Future Expansion

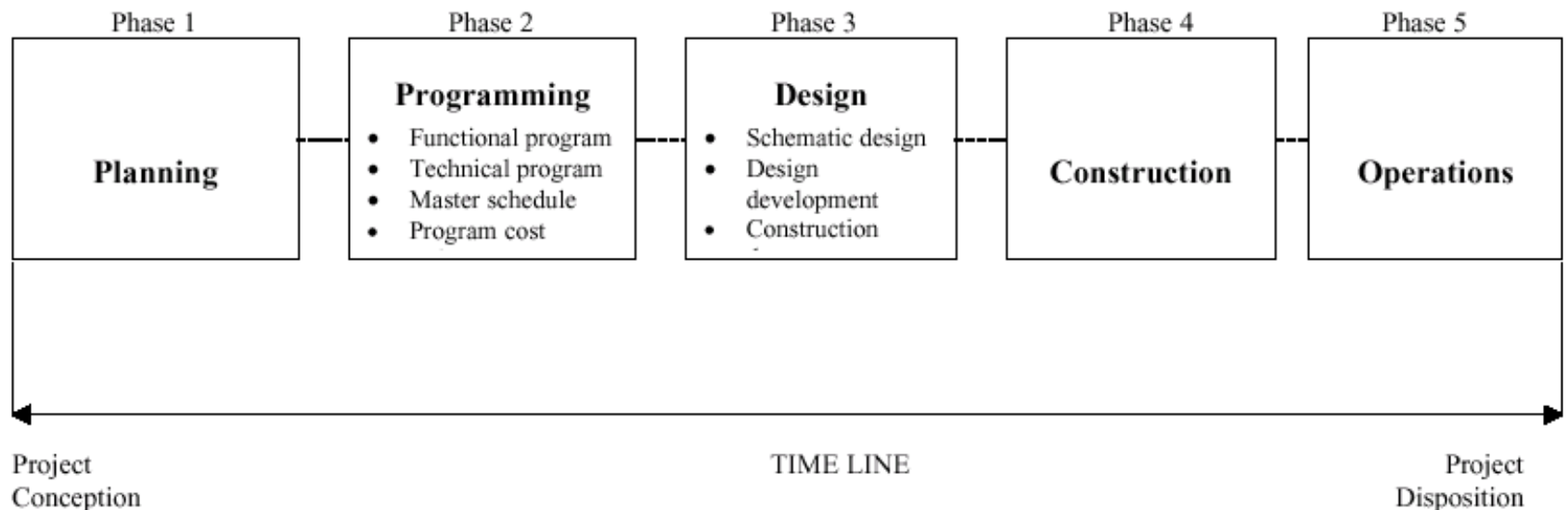
See detailed divisions

<https://secure.spex.ca/siteadmin/freedocuments/images/1.pdf>

Construction Formats

Typical documents where construction formats are used during project phases;

- Programming
- Schematic Design (SD)
- Detailed Design (DD)
- Design Development
- Construction Documents



Interoperability between CIQS and MasterFormat

ELEMENTAL

MASTERFORMAT 2004

A SHELL

- A1 Substructure
- A2 Structure
- A3 Exterior Closure



Division 31	Earthwork
Division 03	Concrete
Division 04	Masonry
Division 05	Metals
Division 06	Wood, Plastics & Composites
Division 07	Thermal & Moisture Protection
Division 08	Openings

B INTERIORS

- B1 Partitions & Doors
- B2 Finishes
- B3 Fittings & Equipment



Division 03	Concrete
Division 04	Masonry
Division 05	Metals
Division 06	Wood, Plastics & Composites
Division 08	Openings
Division 09	Finishes
Division 10	Specialties
Division 11	Equipment
Division 12	Furnishings
Division 13	Special Construction
Division 14	Conveying Systems

C SERVICES

- C1 Mechanical
- C2 Electrical



Division 21	Fire Suppression
Division 22	Plumbing
Division 23	Heating Ventilating & Air-Conditioning
Division 25	Integrated Automation
Division 26	Electrical
Division 27	Communications

D SITE & ANCILLARY WORK

- D1 Site Work
- D2 Ancillary Work



Division 02	Existing Conditions
Division 31	Earthwork
Division 32	Exterior Improvements
Division 33	Utilities

Z GENERAL REQUIREMENTS & ALLOWANCES

- Z1 General Requirements
- Z2 Allowances



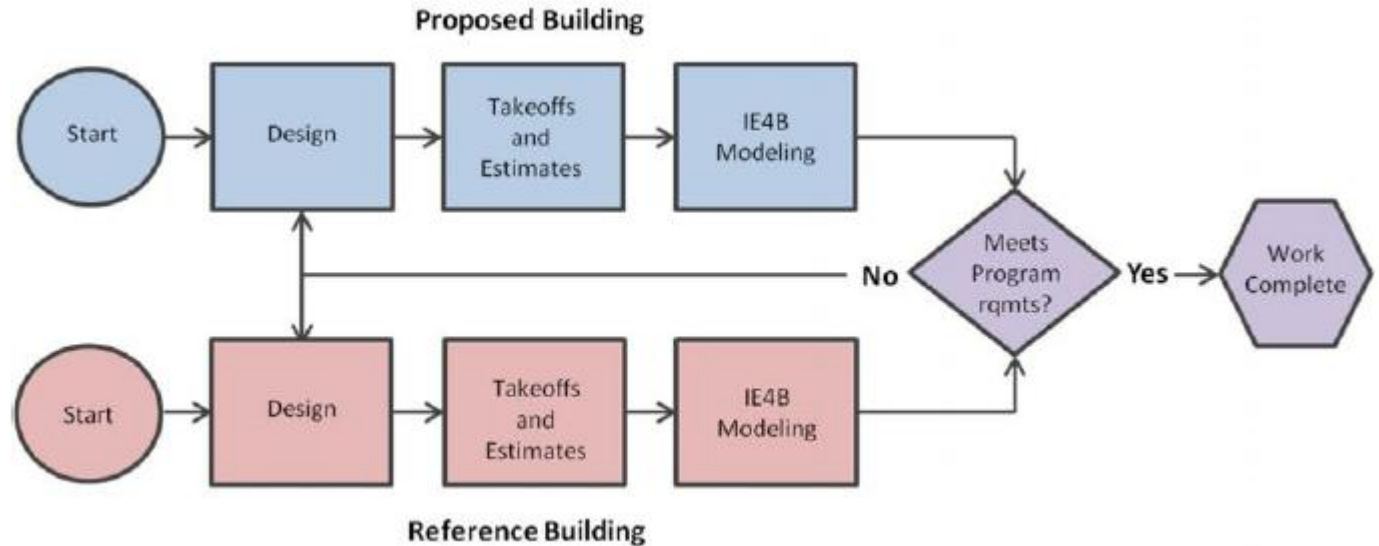
Division 00	Procurement and Contracting Requirements
Division 01	General Requirements

Presentation Outline

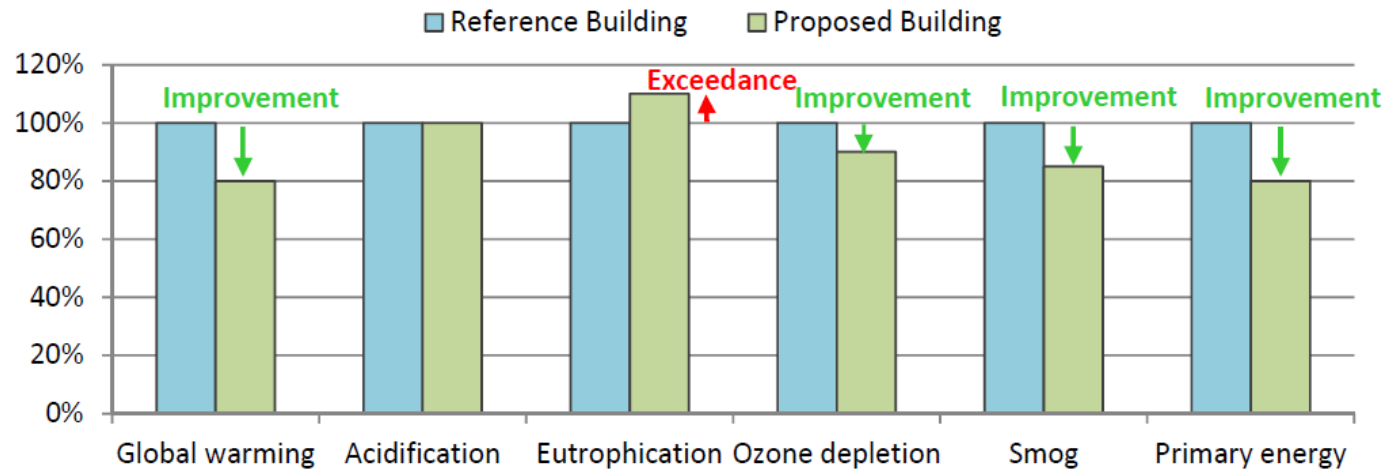
1. Construction Formats
- 2. Quantity Takeoffs**

Quantity Takeoffs

Comparative
LCA Process



Comparative
Concept in
Green Building
Programs



You Input
Building
Information



Define Inputs, such as:

- Building Information (location, life expectancy, occupancy type)
- Operating Energy (energy type – electricity, natural gas, LPG)
- Assembly (geometry, assembly and material type, loading)
- Material (material takeoffs)



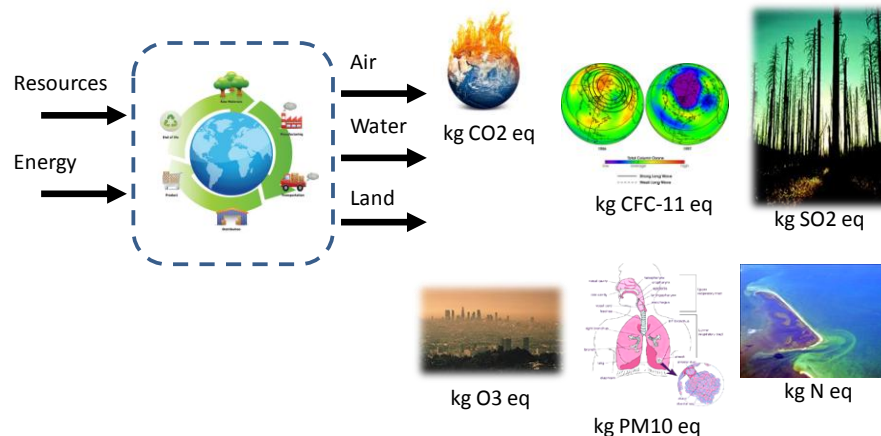
You get life
cycle
information



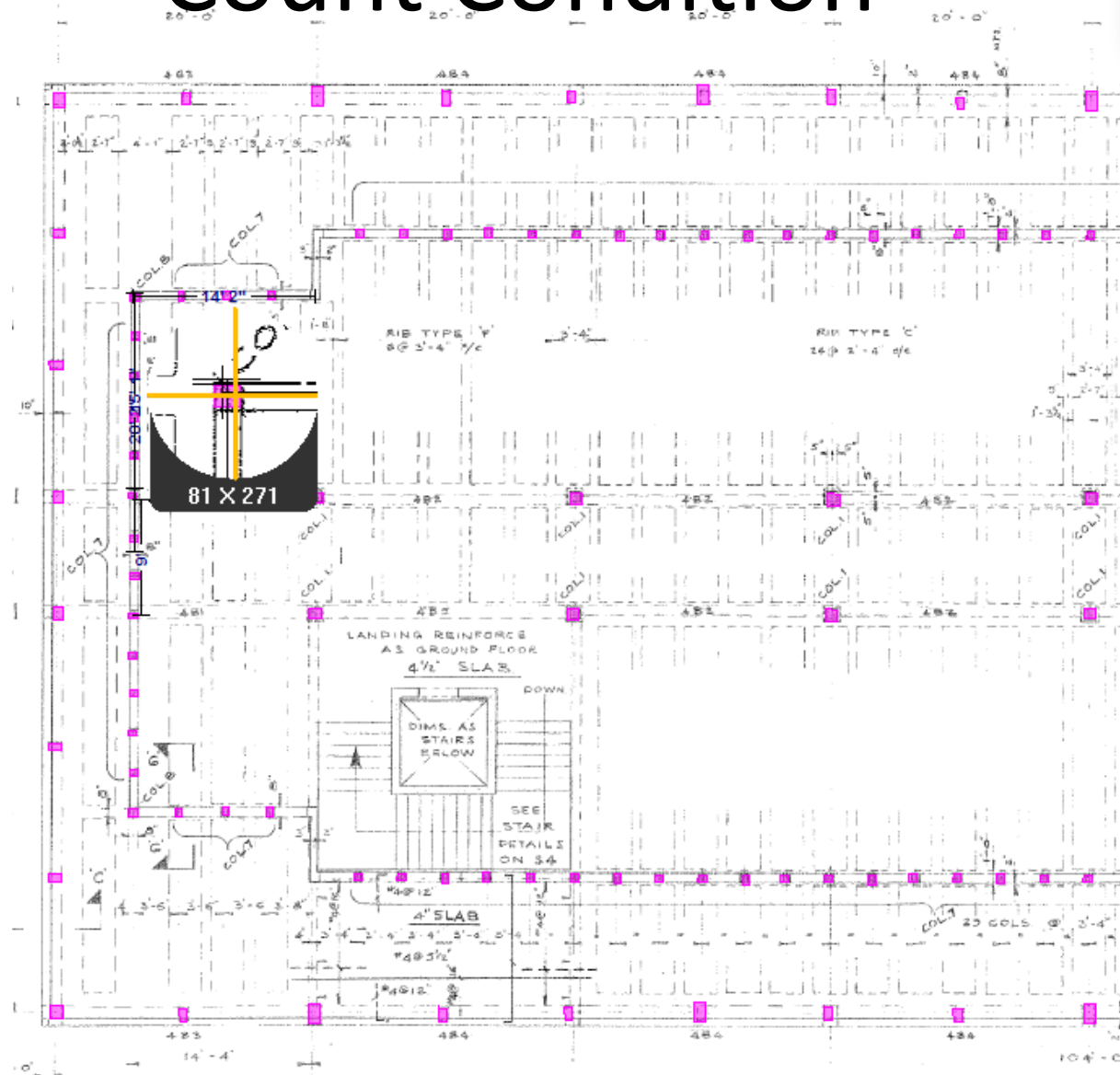
Types of results:

Inventory Analysis

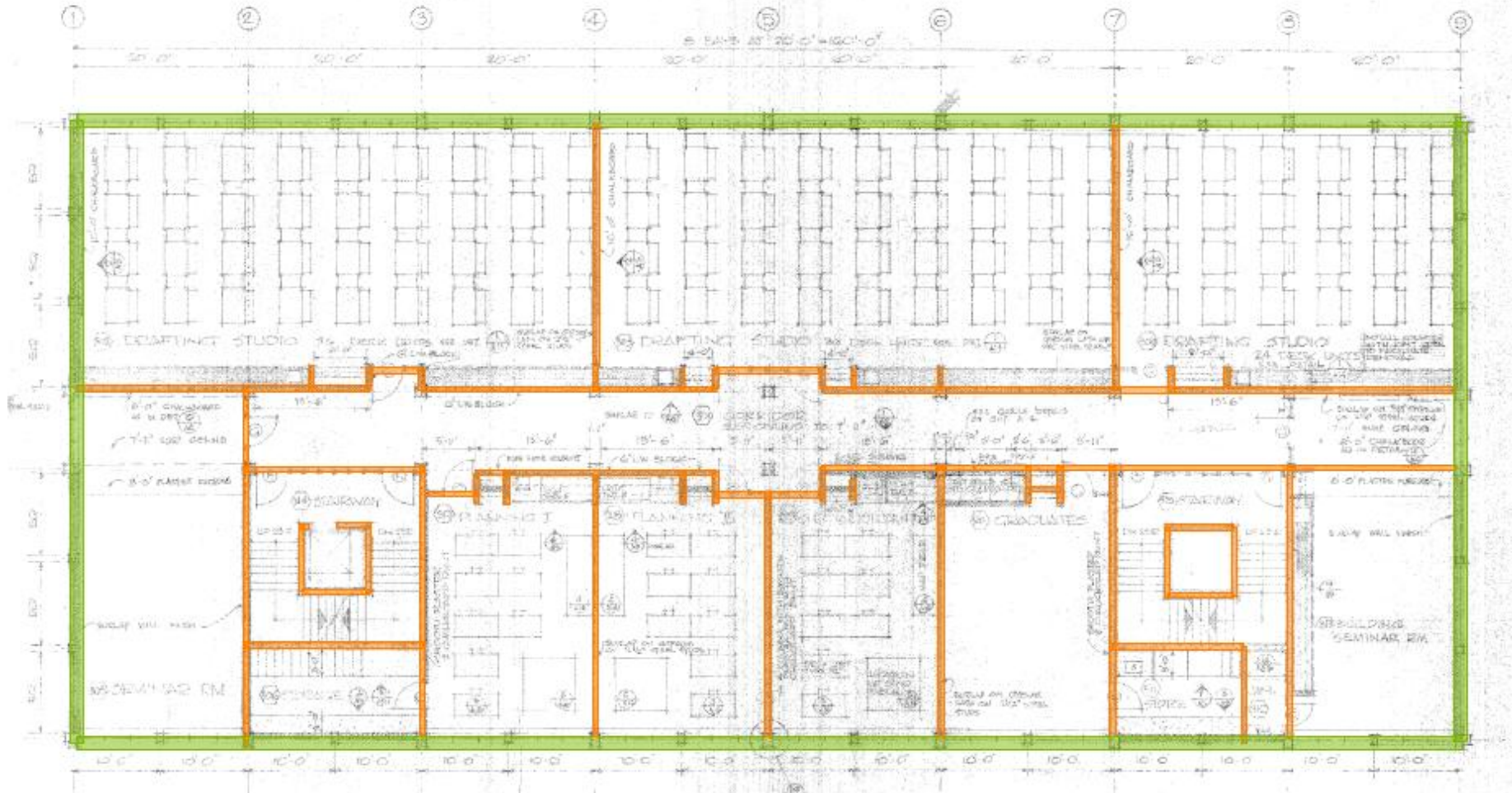
Impact Assessment



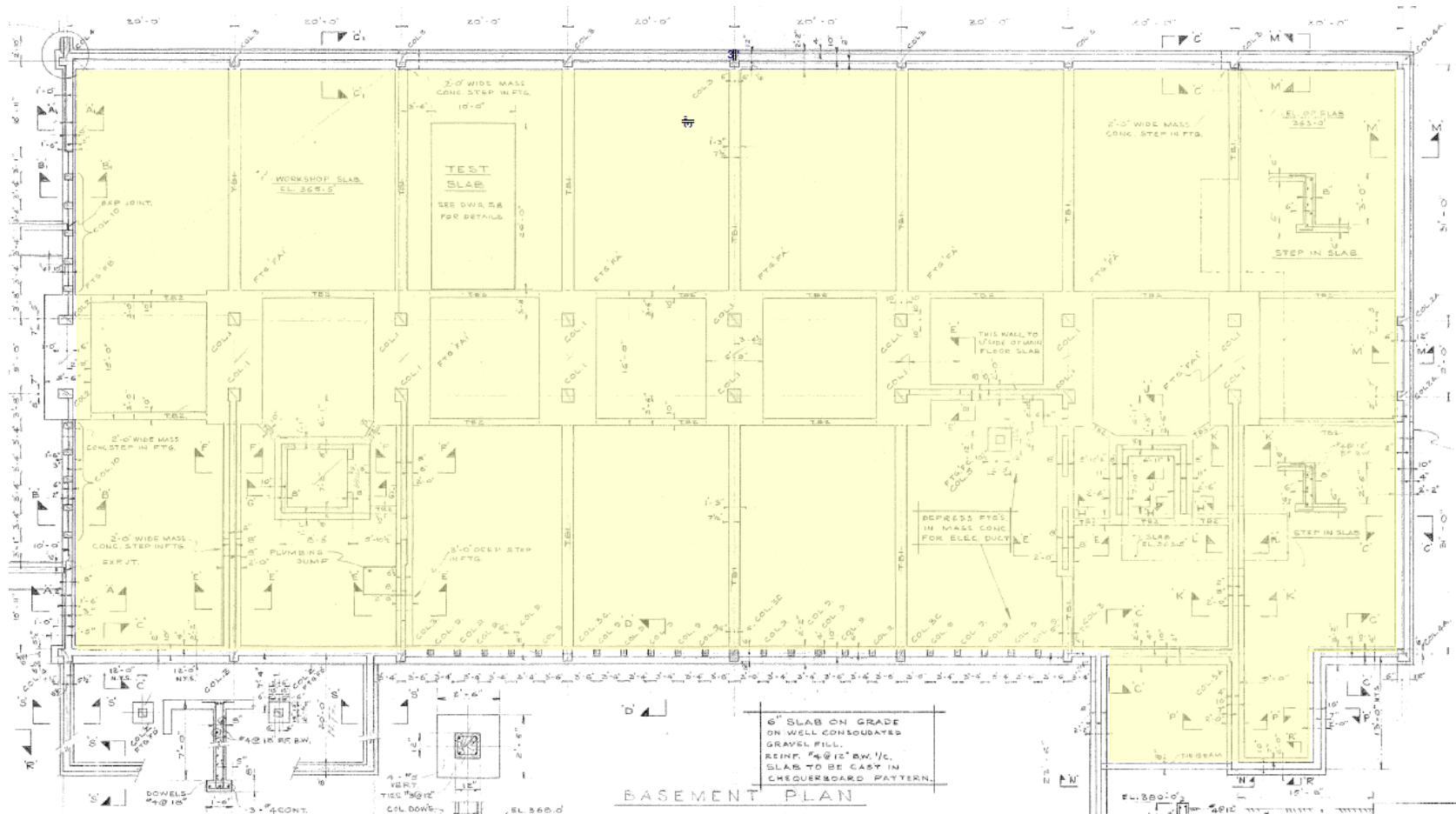
Count Condition



Linear Condition



Area Condition



Ex. Use of takeoffs in CIVL 498C.
Following CIQS methods with modified format.

****See Appendices for Inputs
and Assumptions documents.**

IE Inputs Document - Lasserre

Lasserre Building - GFA 5276m ²							
CIQS Type III Element	Quantity	Units	Assembly Type	Assembly Name	Input Fields	Known/Measured Information	IE Inputs (Imperial)
A11 Foundations	105 5	m ²					
			Footings	Footing_ Strip_Basement_F A_A			
					Length (ft)	59	59
					Width (ft)	1.60	1.60
					Thickness (in)	10	10
					Concrete (psi)	?	3000
					Concrete flyash %	?	average
					Rebar	#4	#4

Ex. Use of takeoffs in CIVL 498C.
Following CIQS methods with modified format.

****See Appendices for Inputs
and Assumptions documents.**

Level 3 CIQS Element	Assembly Type	Assembly Name	Specific Assumptions
A11 Foundations			
	1.1 Concrete Footing		
		Footing _Strip_Basement_F H_H	In The Impact Estimator there is a limitation range of [7.5", 19.7"] for acceptable thickness. In order to find the width corresponding to the corrected thickness the Volume of original footing is calculated and equated to the volume of the corrected footing, to calculate the width related to the corrected volume: $1'2.6" \times 23(\text{ft}) = (19(\text{in}))/12 \times 23(\text{ft}) \times \text{Corrected Width}$ Corrected Width=1.6 (ft)

Ex. Use of takeoffs in Design Practice.

Following CIQS elemental cost analysis methods.

Element	Ratio to GFA	Elemental Cost		Elemental Amount		Rate per m2		%
		Quantity	Unit rate	Sub-Total	Total	Sub-Total	Total	
A SUBSTRUCTURE		1,687 m2			3,351,100		1,686.43	60.2
A11 Foundations	0.822	1,387 m2	300.00	416,100	416,100	246.65	246.65	8.2
A12 Basement Excavation				0		0.00		
A13 Special Conditions				0		0.00		
A2 STRUCTURE					1,421,400		842.56	21.3
A21 Lowest Floor Construction	0.822	1,387 m2	124.80	173,100		102.61		
A22 Upper Floor Construction	0.178	300 m2	899.67	269,900		159.99		
A23 Roof Construction	0.822	1,387 m2	705.41	978,400		579.96		
A3 EXTERIOR ENCLOSURE					1,513,600		897.21	22.7
A31 Walls Below Grade				0		0.00		
A32 Walls Above Grade	1.114	1,679 m2	600.00	1,127,500		668.35		
A33 Windows & Entrances	0.001	1 Sum	56,400.00	56,400		33.43		
A34 Roof Coverings	0.878	1,481 m2	198.45	293,900		174.21		
A35 Projections	0.001	1 Sum	35,800.00	35,800		21.22		
B INTERIORS		1,687 m2			645,800		382.81	9.7
B1 PARTITIONS & DOORS					371,500		220.21	5.6
B11 Partitions	0.810	1,366 m2	279.25	381,500		177.53		
B12 Doors	0.015	25 Lvs	2,880.00	72,000		42.68		
B2 FINISHES					137,500		81.51	2.1
B21 Floor Finishes	1.000	1,687 m2	34.26	57,800		34.26		
B22 Ceiling Finishes	1.000	1,687 m2	20.45	34,500		20.45		
B23 Wall Finishes	1.671	2,819 m2	16.03	45,200		26.79		
B3 FITTINGS & EQUIPMENT					136,800		81.09	2.1
B31 Fittings & Fixtures	1.000	1,687 m2	45.52	76,800		45.52		
B32 Equipment	1.000	1,687 m2	0.00	0		0.00		
B33 Elevators	0.001	1 No	60,000.00	60,000		35.57		
C SERVICES		1,687 m2			1,322,500		783.94	19.8
C1 MECHANICAL					835,300		495.14	12.5
C11 Plumbing & Drainage	1.000	1,687 m2	125.90	212,400		125.90		
C12 Fire Protection	1.000	1,687 m2	64.32	108,500		64.32		
C13 HVAC	1.000	1,687 m2	247.13	416,900		247.13		
C14 Controls	1.000	1,687 m2	57.79	97,500		57.79		
C2 ELECTRICAL					487,200		288.80	7.3
C21 Service & Distribution	1.000	1,687 m2	87.31	147,300		87.31		
C22 Lighting, Devices & Heating	1.000	1,007 m2	127.00	215,000		127.00		
C23 Systems & Ancillaries	1.000	1,687 m2	73.68	124,300		73.68		
NET BUILDING COST - EXCLUDING SITE				\$	5,319,400		3,153.17	79.7
D SITE & ANCILLARY WORK		1,687 m2			460,500		272.97	6.9
D1 SITE WORK					460,500		272.97	6.9
D11 Site Development	1.126	1,900 m2	103.68	197,000		116.78		
D12 Mechanical Site Services	0.001	1 Sum	158,000.00	158,000		93.66		
D13 Electrical Site Services	0.001	1 Sum	105,500.00	105,500		62.54		
D2 ANCILLARY WORK					0		0.00	0.0
D21 Demolitions	0.001	1 sum	0.00	0		0.00		
NET BUILDING COST - INCLUDING SITE				\$	5,779,900		3,426.14	86.6
Z1 GENERAL REQUIREMENTS & FEE					896,900		531.06	13.4
Z11 General Requirements		10.0 %		578,000		342.62		
Z12 Fee		5.0 %		317,900		188.44		
TOTAL CONSTRUCTION ESTIMATE - EXCLUDING ALLOWANCES				\$	6,675,800		3,957.20	100.0
Z2 ALLOWANCES					506,000		301.72	
Z21 Design & Pricing Allowance		5.0 %		333,800		197.87		
Z22 Escalation Allowance		0.0 %		0		0.00		
Z23 Construction Allowance		0.0 %		0		0.00		
Z24 LEED Gold Allowance		8.5 %		175,200		103.85		
TOTAL CONSTRUCTION ESTIMATE - INCLUDING ALLOWANCES				\$	7,181,800		4,258.92	
VALUE ADDED TAX (GST/HST)					0		0.00	
HST		0.0 %		0		0.00		
TOTAL CONSTRUCTION ESTIMATE				\$	7,181,800	\$	4,258.92	

Ex. Use of takeoffs in
Design Practice.

Following CIQS
elemental cost analysis
methods.

A2 STRUCTURE		Quantity	Unit rate	Amount
A21 Lowest Floor Construction				
1	Concrete slab on grade (150mm)	1,039 m2	73.50	76,400
	- Concrete - supply and place	156 m3	230.00	35,900
	- Reinforcing	4,083 kg	1.90	7,800
	- Granular material (allow 200mm)	208 m3	75.00	15,600
	- Finishing	1,039 m2	11.50	11,900
	- Construction joints	1,039 m2	5.00	5,200
2	Concrete slab on grade (100mm)	348 m2	62.40	21,700
	- Concrete - supply and place	35 m3	230.00	8,100
	- Reinforcing	1,368 kg	1.90	2,600
	- Granular material (allow 200mm)	70 m3	75.00	5,300
	- Finishing	348 m2	11.50	4,000
	- Construction joints	348 m2	5.00	1,700
3	Allowance for housekeeping pads	1 Sum	75,000.00	75,000
A21 Lowest Floor Construction		TOTAL : \$	1,387 m2	124.80
				173,100

Quantity Takeoffs

See 'CIVL 498C Elemental Construction Format'
<http://civl498c.wikispaces.com/Final+Project>

Slide 3 in column “Other CIQS Level 3 Elements to be included for CIVL 498C Final Projects” shows how CIQS format is modified for CIVL 498C project, primarily to match what is included IE4B assemblies.

Presentation Outline

1. Construction Formats
2. Quantity Takeoffs